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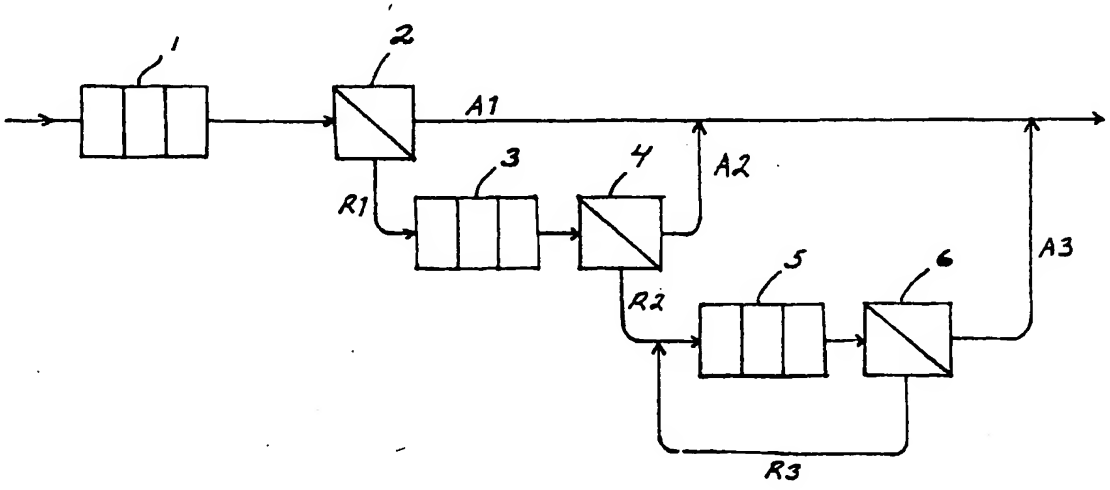
(54) Title: RAW MATERIAL FOR PRINTING PAPER, METHOD TO PRODUCE IT AND PRINTING PAPER



(57) Abstract: The object of the present invention is a method for making mechanical pulp, such as thermomechanical or chemi-thermomechanical stock. The mechanical pulp is utilised as a raw material for printing paper, and its freeness value is 30-70 ml CSF. According to the method, the refined stock is screened in several stages into accept and reject stock portions. The stock is screened at a consistency of not less than 10 %.

WO 01/42557 A1

Raw material for printing paper, method to produce it and printing paper

The present invention relates to stock, a method for preparing it, the use of the stock as a raw material for producing printing paper, especially newsprint, and a printing paper. The stock produced in accordance with the method of the present invention can be used as a raw material for producing different papers, such as SC paper (supercalendered) comprising both offset and gravure grades, coated paper having a low grammage or LWC paper (light weight coated) comprising both offset and gravure grades, and newsprint or corresponding printing papers. Newsprint also comprises other grades of paper than those used in newspapers, e.g. catalogue papers and gravure papers.

A known method for producing mechanical pulp is presented in patent publication US 5 145 010, corresponding to international application WO 8906717 and Swedish patent publication SE 459924. The method comprises the following phases:

- impregnating softwood chips with water and chemicals
- primary refining of the treated chips
- fractionating the refined softwood pulp into accept and reject stock portions, whereby the reject portion comprises 15 - 35% of the refined stock
- refining of the reject stock portion in two steps, whereby the stock consistency in the first step is approximately 20-35% and in the third step approximately 5%, and
- the above-mentioned stock is fractionated to form an accept stock portion and a reject stock portion. The fractionation is carried out with a screen.

A known method for producing mechanical pulp is presented in patent publication US 4 938 843. The process involves the production of chemi-thermomechanical stock. The chips impregnated with chemicals and treated with heat are refined to a freeness value of 100-700 ml CSF, usually in a two-

phase refining process and screened to form a first accept stock portion and a first reject stock portion, so that at least 30% of the stock goes into the reject stock portion. The consistency of the stock during the screening is approximately 2%. The first accept stock portion is screened for a second time, whereby a second accept stock portion and a second reject stock portion are formed. The first and the second reject stock portions are combined, creating a long-fibre fraction with a freeness value of 200-750 ml CSF, which can be used separately to produce coarse-fibred products, for example cardboard, or it can be further refined and returned to the first screening.

A known method is the method for producing stock described in the introductory part of patent claim 1 of the present application, in which method the process is begun with two-phase refining. The chips are fed into the first refiner, from which they are fed into the second refiner after the first refining is complete. After the second refiner, the freeness value of the stock is about 120 ml CSF. The consistency is typically 50% at the first refiner and 45% at the second refiner. After the first refiner, the measured average fibre length, when using spruce as the raw material, is approximately 1.7 mm, and after the second refiner the average fibre length when using the same raw material, is approximately 1.5 mm. After the second refiner there is a latency chest, in which the fibres are straightened by diluting the consistency to 1-2%. The fibres are treated in the latency chest for one hour. The fibres are conveyed to the first screen, which fractionates the stock into an accept portion and a reject portion. The freeness value of the accept stock portion is about 20 ml CSF. Water is removed from the reject stock portion to obtain a consistency of 45%. The reject stock portion, which constitutes 40-50% of the total stock, is conveyed to the third refiner, from which the reject stock diluted to a consistency of 1%, is transported on to a second screen. Again the stock is fractionated into an accept stock portion and a reject stock portion. The reject stock portion is conveyed, after the removal of water, at a consistency of 45%, to a fourth refiner and after being diluted to a consistency of 1%, on to a third screen. The reject stock portion from this screen is fed again to the fourth refiner. The stock obtained from the process has a freeness value of 30-70 ml CSF,

advantageously about 50 ml CSF. The pressure used in the refiners is 350-400 kPa. The process consumes about 3.3 MWh/t of energy (using spruce as the raw material), 0.3 MWh/t of which is used for regulating the consistency so as to be suitable for every stage of the process.

In the process mentioned above, regulating the consistency to a suitable level consumes 9-10% of the total energy used in the process. In the present application, consistency refers to the amount of stock as a percentage by weight in the mixture of pulp and water. The water can be either in vapour or in liquid form.

After the refining, a latency chest, in which the fibres remain, is needed to straighten the fibres. Regulating stock consistency requires the use of suitable equipment, for example presses to press water out and pumps to pump water into the process. This means that the process is prolonged and the equipment for the process is complex. In addition, the problems of the known processes include high energy consumption, a relatively short average fibre length of the obtained stock, and mainly due to this, deficiencies in the tensile strength and tear resistance of the printing paper produced from the stock.

The above-mentioned problems can be reduced by the method of the present invention for producing stock, the stock itself, the use of the stock in producing printing paper and the printing paper itself. The method of producing stock in accordance with the present invention is characterised in that the stock is screened at a consistency of no less than 10%. The stock produced in accordance with the present invention is characterised in that at least 40% by weight of the fibres do not pass through a Bauer-McNett screen with a mesh size of 28. The printing paper produced in accordance with the present invention is characterised in that it has been made of stock that has been produced by the method in accordance with the present invention, or stock that has the same fibre distribution as the stock produced by the method of the present invention.

In the method of producing stock in accordance with the present invention, the stock is screened at a high consistency, whereby it is not necessary to change the consistency to suit each refining step between the refiner and the screen, but the refining and screening can be done at essentially the same consistency. The amount of energy that is consumed for pumping water into the process and pressing it out of the stock can thus be saved. When using the new screening method, there is no need for pumps to pump water, presses to remove water or a latency chest between the refining and screening steps of the process, whereby the process becomes simpler.

When using the new type of screen that screens stock at a high consistency, the quality of the stock improves because the screen efficiently separates the coarser fibres that need further refining into a reject fraction, and flexible, long fibres into an accept portion. In this way the printing paper produced from the long-fibre stock has good formation. The resin remains in the fines because, due to the high consistency, it cannot spread onto the surface of the fibres.

The screen is simple and does not contain moving parts and therefore its manufacture and maintenance costs are low. The size of the screen is small because the screening process is carried out at a high speed. Due to its small size, the manufacturing costs of the screen are low. The screen can utilise the steam produced in the refiner as the screening force, as a result of which no separate sources of power are necessarily required.

In addition, thanks to the new refining process, the energy consumption is lower than in the known methods which aim at the same freeness value. In this patent application, freeness refers to Canadian Standard Freeness, the unit of which is ml CSF. Freeness can be used to indicate the refining degree of the stock. According to the literature, the following correlation exists between the freeness and the total specific area of the fibre:

$$A = -3.03 \ln (CSF) + 21.3$$ where

A = the total specific area of the stock (unit m^2/g).

According to the formula mentioned above, the total specific area of the stock increases as the freeness decreases, that is, the freeness gives a clear indication of the refining degree because, as the proportion of fines grows, the specific area of the fibres increases.

In accordance with the present invention, the process produces mechanical stock in which the proportional amount of long fibres is high. The term mechanical stock is used in this application to indicate stock produced by refining wood raw material, such as chips. In connection with the refining, the wood raw material and/or stock is heat-treated in order to soften the wood raw material, in which case the process is that of producing thermomechanical pulp. The wood raw material may have also been treated with chemicals before being refined, in which case the process is that of producing chemi-thermomechanical pulp.

Because the average fibre length of stock produced in accordance with the new method is longer, the tensile strength and tear resistance of printing paper produced from this stock consisting of primary fibres are also improved. The proportion of long fibres in the stock is higher than in stocks produced by the known methods, such as the stock described above as the product of the process closest to the state of the art. In the new method, the proportion of short fibres remains more or less the same as in the known methods, but the proportion of fibres of medium length decreases in the stock produced by the new method.

The stock can be used to manufacture printing paper, for example, newsprint, the grammage of which can be lower than that currently used in newsprint, while the properties of the paper still remain good. The stock can be used to manufacture newsprint, the grammage of which can be 30—40 g/m^2, measured at a temperature of 23°C and at a relative humidity of 50%.

Because paper with good strength properties can be obtained as the end product when utilising the manufacturing method presented by this invention,

more fillers can be used to replace fibre than at present. For supercalendered paper, the filler content to be used can be approximately 30%, and for newsprint 7—15%, advantageously approximately 10%. It is noteworthy that the stock can be used to manufacture printing paper, the grammage of which can be lower than that of the printing paper normally used at present, and at the same time the filler content can be increased, even though fillers reduce the strength of the paper. Fillers are cheaper than fibre raw material and improve the light scattering coefficient and opacity of the paper.

The tree species that have been presented in this application as suitable raw materials are spruce (Picea abies), pine (Pinus sylvestris) and southern pine (genus Pinus, several different species). It is also feasible that the stock made of wood raw material may contain stock obtained from at least two different tree species and/or stock prepared in at least two different ways, which at a suitable phase of preparation are mixed with each other. For example in supercalendered paper and in low-grammage coated papers, chemical pulp obtained by chemical cooking is generally one of the raw materials used, whereas it is not used in newsprint . The amount of chemical pulp in supercalendered paper is usually 10–20%, and in low-grammage coated papers 20–50% of the pulp composition. The pulp composition refers to the total fibre stock used for the manufacture of paper.

The properties required for newsprint grade, which is one important use of the stock presented in this patent application, are runnability, printability and appearance. What is meant by good runnability is that the paper can be conveyed through a printing machine without breaks in the web. Paper properties affecting the runnability of paper include tear resistance, formation, tensile strength, elongation and variation in grammage.

Printability means the ability of the paper to receive the print and to retain it. Printing ink must not come off when rubbed, transfer from one sheet to another or show through the paper. Paper properties affecting the printability of paper

include, for example, smoothness, absorbency, moisture content, formation, opacity, brightness, porosity and pore size distribution.

The appearance of the paper can be judged by its optical properties, such as brightness, whiteness, purity and opacity.

The basic idea of the stock preparation method presented in this invention is to use a simple and energy saving process to manufacture stock in which there is a high relative proportion of long fibres. The average fibre length obtained by utilising the method is approximately 10% longer than in the prior art method. At the first stage of refining the wood raw material is refined at a high temperature, advantageously at a temperature of 165–175°C, and at a superatmospheric pressure of over 400 kPa, advantageously at a superatmospheric pressure of 600–700 kPa, for only a very short time, as a result of which the stock remains quite coarse after the first stage of refining. What is meant by superatmospheric pressure is the pressure in comparison with normal atmospheric pressure. The average retention time of the raw material to be fed in the high pressure refiner is only 5–10 seconds. The temperature at which refining takes place is determined by the pressure of the saturated vapour.

After the first stage of refining, the stock is screened so as to produce a first accept stock portion and a first reject stock portion. When the stock has been screened into a first accept stock portion and a first reject stock portion, there are different possible procedures for continuing the process, such as

- 1-step processing of the first reject stock portion, in which the reject stock portion is refined and screened in one step. Accept stock portions are taken out of the process after each stage of screening and/or accept stock portions are re-screened, or
- 2-step processing of the first reject stock portion, in which the reject stock portion is refined and screened in two steps. The accept stock portions are taken out of the process after each stage of screening and/or accept stock portions are re-screened, or

- 3-step processing of the first reject stock portion, in which the reject stock is refined and screened in three steps and the accept stock portions are taken out of the process after each screening stage, or
- forward-connected 2- or 3-step processing of reject stock, which means the processing of the reject stock first in two or three steps and the removal of the accept stocks after each screening stage, and thereafter the refining of the last reject stock portion, for example, in a low-consistency refiner and removal from the process of the whole stock processed in the low-consistency refiner.

In the above-mentioned alternatives, one step consists of a successive refiner and screen. Further on, the above-mentioned embodiments are described in detail. The accept stock portions obtained at different stages of the process are combined and mixed, possibly bleached, and utilised as a raw material for making paper in a paper machine. The machinery for preparing the stock may consist of several parallel processing lines, from which all the obtained accept stock portions are combined.

The first stage of refining, the so-called primary refining, is advantageously conducted in a one-stage process. There may, however, be several parallel refiners at the same stage. A refiner may be a conical or a disc refiner, advantageously a conical refiner. A conical refiner produces longer pulp fibres than a disc refiner. After the first stage of refining, the pulp is screened into a first accept stock portion and a first reject stock portion. Screening is conducted at a high consistency, of not less than 10%. More advantageously, screening is conducted at a consistency of not less than 20%, and most advantageously at a consistency of not less than 40%. However, the consistency of the material being screened may not be more than 90%, more advantageously not more than 80% and most advantageously not more than 60%.

The stock is fed into a refiner either by means of a separate power source, for example, compressed air, or by utilising the outlet pressure of a refiner, which pressure at the first stage of refining is over 400 kPa, advantageously 600-700

kPa, and at the subsequent stages after the first stage of refining, either over 400 kPa, advantageously 600-700 kPa, or not more than 400 kPa, advantageously 300-400 kPa. The stock leaving the refiner is a mixture of steam and fibres with a consistency of 40-60%. The water is in the form of steam.

The process results in a stock with a freeness value of 30-70 ml CSF. Stock of this kind is suitable for making printing papers, and because the stock also contains very long fibres, the paper will possess good strength properties. The paper will also have good printing properties.

The fibre distribution of a ready-made stock measured according to the Bauer McNett characterisation is as follows:

40-50% of the fibres do not pass through screens of 16 mesh and 28 mesh,
15-20% of the fibres pass through screens of 16 mesh and 28 mesh, but do not pass through screens of 48 mesh and 200 mesh, and
35-40% of the fibres pass through screens of 48 mesh and 200 mesh, in other words these fibres pass through all the screens used (-200 mesh).

The average fibre length of fibres retained on a screen of 16 mesh is 2.75 mm, the average fibre length of fibres retained on a screen of 28 mesh is 2.0 mm, the average fibre length of fibres retained on a screen of 48 mesh is 1.23 mm and the average fibre length of fibres retained on a screen of 200 mesh is 0.35 mm. (J. Tasman: The Fibre Length of Bauer-McNett Screen Fractions, TAPPI, Vol.55, No.1 (January 1972))

The stock thus obtained contains 40-50% of fibres with an average fibre length of over 2.0 mm, 15-20% of fibres with an average fibre length of over 0.35 mm, and 35-40% of fibres with an average length of less than 0.35 mm.

In the following, the invention is described in more detail with reference to Figures 1–6.

Figures 1–5 show schematic diagrams for the stock preparation process, all of which are different embodiments of the same invention, and

Figure 6 shows a possible structure of a screen, where Figure 6a shows the screen from the side and Figure 6b shows the screen seen from above.

Before feeding the chips into the process according to Figure 1, the chips are pre-processed in hot steam under pressure, whereby the chips are softened. The pressure used in the pre-processing is advantageously 50–800 kPa. Chemicals e.g. alkaline peroxide or sulphites, such as sodium sulphite, can also be used in the pre-processing of the chips. Means for separating the steam, such as cyclones, are usually also used in the process before the refiners.

In the process according to Figure 1, the chips are conveyed at a consistency of 40–60%, e.g. at a consistency of about 50%, to refiner 1, which produces stock with a freeness value of 250–700 ml CSF. When spruce (*Picea abies*) is used as the raw material, the average fibre length after refiner 1 is at least 2.0 mm. The pressure in refiner 1 is high, a superatmospheric pressure of more than 400 kPa, advantageously 600–700 kPa. The refiner can be a conical or a disc refiner, advantageously a conical refiner. The stock obtained from a conical refiner has a longer fibre length than that from a disc refiner. The energy consumption with refiner 1 is 0.3–1.1 MWh/t when the chips have not been processed with chemicals.

The stock is fed to screen 2 at essentially the same consistency as to refiner 1, i.e. a consistency of 40–60%, advantageously at about 50%.

Screen 2 gives the first accept stock portion A1 with a freeness value of 20–50 ml CSF. The first reject stock portion R1 constitutes 60–90%, advantageously about 80%, of the total stock. The first reject stock portion R1 is fed at a consistency of 30–60%, advantageously at a consistency of about 50%, to refiner 3 and from

there onwards at essentially the same consistency to screen 4. The energy consumption of refiner 3 is 0.4–1.7 MWh/t.

From screen 4 are obtained the second accept stock portion A2 and the second reject stock portion R2, which comprises 60–80% of the first reject stock portion R1 rejected by screen 4 at the previous stage. The second reject stock portion R2 is fed, at a consistency of 30–60%, advantageously at a consistency of 50%, to refiner 5 and from there onwards at essentially the same consistency to screen 6, from which are obtained the third accept stock portion A3 and the third reject stock portion R3, which is returned to be fed into refiner 5. The energy consumption of the refiner is 0.4–1.7 MWh/t. The total stock, which is obtained by combining the accept stock portions A1, A2 and A3, has a freeness value of 30–70 ml CSF.

At refiners 3 and 5 the pressure can be high, at least over 400 kPa, advantageously 600–700 kPa, or it can be at a normal level, not more than 400 kPa, advantageously 300–400 kPa.

The finished stock, which has been obtained by combining and mixing the accept stock portions A1, A2 and A3, has a fibre distribution, measured by the Bauer-McNett method, as follows:

40–50% of the fibres do not pass through screens of 16 and 28 mesh,
15–20% of the fibres pass through screens of 16 and 28 mesh, but do not pass through screens of 48 and 200 mesh, and
35–40% of the fibres pass through screens of 48 and 200 mesh.

Figure 2 shows an embodiment of the invention. The initial stage of the process is like the process shown in Figure 1, but the third reject stock portion R3 is, instead, conveyed to refiner 7 and from there on to screen 8. The fourth accept stock portion A4, obtained from screen 8, is taken to be combined with the other accept stock portions A1, A2 and A3. The fourth reject stock portion R4 is

returned to the inlet of refiner 7. This kind of procedure may be necessary when aiming at a low freeness level, e.g. a level of 30 ml CSF.

Figure 3 shows another embodiment of the invention. The initial stage of the process proceeds as in the process shown in Figure 2, but the fourth reject stock portion R4 is conveyed to low-consistency-refiner LC. The consistency of the stock portion R4 fed into low-consistency-refiner LC is 3–5%. The accept stock portions A1, A2, A3, A4 and A5 obtained are combined and mixed to form a ready-made stock.

Figure 4 shows a third embodiment of the invention. The first reject stock portion R1 obtained from screen 2, is conveyed to refiner 3 and from there onwards to screen 4. The reject stock portion obtained from screen 4 is conveyed back to the inlet of refiner 3. The accept stock portion A2 obtained from screen 4 is taken out of the process.

The accept stock portion A1, obtained from screen 2, is conveyed for re-screening to screen 10. The accept stock portion A11 obtained from screen 10, is taken out of the process. The reject stock portion R11 obtained from screen 10, is conveyed to refiner 11 and from there on to screen 12. The reject stock portion R12, obtained from screen 12, is conveyed back to the inlet of refiner 11. The accept stock portion A12 obtained from screen 12, is taken out of the process to be combined with the other accept stock portions A11 and A2.

Figure 5 shows a fourth embodiment of the invention. The process is otherwise the same as that shown in Figure 1, but the accept stock portion A1 obtained from screen 2 is conveyed for re-screening to screen 13. The accept stock portion A13 obtained from screen 13, the accept stock portion A2 obtained from screen 4 and the accept stock portion A3 obtained from screen 6, are combined and mixed. The reject stock portion R13 obtained from screen 13 is combined with the reject stock portions R2 and R3, and the combined stock is conveyed to refiner 5.

In the above mentioned processes as shown in Figures 1–5, the wood raw material used can be any species of wood, but it is usually softwood, advantageously spruce, but e.g. pine and southern pine are also suitable wood raw materials for the purpose. When the wood raw material used is spruce and the chips have not been pre-treated with chemicals, the total energy consumption of the process is approximately 2.5 MWh/t. In this case, a freeness value of 30–70 ml CSF is achieved for the stock. Using the process shown in Figure 1, the energy consumption at the first stage of refining is 0.3–1.1 MWh/t, at the second stage of refining 0.4–1.7 MWh/t, and at the third stage of refining 0.4–1.7 MWh/t. The required amount of energy is higher when processing pine than when processing spruce, e.g. processing southern pine requires approximately 1 MWh/t more energy than spruce. Also, changes in the size of chips affect the energy consumption. The energy consumption rates mentioned above are calculated according to a chip screening test, where the average length of a chip was 21.4 mm and the average thickness 4.6 mm.

Stock prepared by the methods described above, as shown in Figures 1–5, is used as a raw material for printing papers. The proportion of long fibres in such stock is high, so that they are able to form a reinforcing mesh in the paper. In spite of this, the formation of the paper is good and therefore good printing properties can be achieved.

Figure 6 shows a possible embodiment of a screen to be used in the process. The screen used in the process is a new type of screen that makes it possible to screen relatively long-fibre stock easily. The screen comprises a cylindrical chamber, where the ratio between its diameter and the length of the housing is in the range of 1–10. The diameter of the screen is thus the same as or greater than the length of the housing. By the length of the housing is meant the perpendicular distance between the cylindrical chamber's plate-like sidewalls 26 and 27. A typical diameter for the chamber is approximately 1 m and the length of the housing 0.2 meters. The screen may contain a means for improving the screening, such as a screen drum, but this is not necessary.

The stock is conveyed tangentially from the refiner through a feed pipe from an inlet point 23 to the chamber 21, where a swirling motion is imparted to the stock by the lowering of pressure. In the spirally rotating stream of stock, the stock moving in the middle reaches a higher speed than that of the stock moving near the outermost edges, whereby the accept stock portion moves towards the centre of the screen, and the reject stock portion to the inner perimeter of the cylinder or close to it. Separating is done on the basis of the mass, size, and the surface area of the fibres. There are outlets in the screen for both the accept stock portion, and the reject stock portion. The accept stock portion is passed out through an outlet pipe from the centre of cylinder 24, and the reject stock portion is passed out through an outlet pipe from the perimeter of cylinder 25. The inlet and the outlet pipes may be installed in different positions lengthwise on the cylinder's housing, or there may be several inlet and outlet pipes. The screen can be placed so that the cylindrical part of the chamber stands either vertically or horizontally.

The speed of the mixture of fibre and steam leaving the refiner is increased to a suitable speed that will produce the desired screening result, advantageously to a speed of 200–800 m/s, by choosing an appropriate diameter for the inlet pipe, or by adding appropriate nozzles to the pipe to regulate the flow. At such a speed, the coarse particles drift to the screen cylinder's sides, and the flexible, pliable fibres to the centre.

Several screens can be placed in line, whereby the accept stock portion of the next stage is returned to the inlet of the previous stage. In this way the reject stock portion is carefully separated from the accept stock portion, and only the stock that in fact needs further refining, is conveyed to re-refining.

The invention is not limited as regards the wood raw material solely to the tree species mentioned, but other tree species can also be used, although, for example, the energy consumption of the process and the average fibre length obtained vary depending on the wood raw material. The stock can contain fibres from different tree species.

The method for producing stock as claimed in the invention is not solely limited to methods where the first stage of the refining is performed at a pressure of over 400 kPa, but it can also include methods where refining takes place at a lower pressure.

The method for preparing stock may vary after the first phase of refining. The stock can be used for producing various types of printing paper. The core idea of the invention is that the stock refined and screened by a certain new method, is suitable as a raw material for printing papers, and makes it possible to produce printing paper more cost-efficiently than before. The main point is that the stock is screened at a consistency of not less than 10%.

Patent claims

1. A method for producing mechanical pulp, such as thermomechanical or chemi-thermomechanical pulp, for use as a raw material for printing paper, in which the freeness value of the ready-made stock is 30-70 ml CSF, and in which method the refined stock is screened in several stages into accept and reject stock portions, characterised in that the stock is screened at a consistency of not less than 10%.

2. A method as claimed in claim 1, characterised in that the stock is screened at a consistency of 30-60%.

3. A method as claimed in claim 1, characterised in that the screening of the stock takes place at essentially the same consistency as refining.

4. A method as claimed in any of the previous claims 1-3 characterised in that screening is carried out by means of a screen, the ratio of the screen's diameter to the length of its housing being 1-10.

5. A method as claimed in claims 1-4, characterised in that wood raw material is refined at a superatmospheric pressure of over 400 kPa, advantageously at a superatmospheric pressure of 600-700 kPa.

6. A method as claimed in claim 5, characterised in that the freeness value of the refined stock is 250-700 ml CSF.

7. A method as claimed in claims 1-6 characterised in that, after refining, the pulp is screened into an accept (A1) and a reject (R1) stock portion.

8. A method as claimed in claim 7 characterised in that the freeness value of the accept stock portion (A1) is 20-50 ml CSF.

9. A method as claimed in claim 7 and 8 characterised in that said first accept stock portion (A1) is taken out of the process.

10. A method as claimed in claim 7 and 8 characterised in that said first accept stock portion (A1) conveyed to re-screening.

11. A method as claimed in claim 10 characterised in that the first accept stock portion (A1) is re-screened to form a secondary accept stock portion (A11) and a secondary reject stock portion (R11).

12. A method as claimed in claim 11 characterised in that the accept stock portion (A11) is taken out of the process.

13. A method as claimed in claims 11 and 12 characterised in that the reject stock portion (R11) is conveyed to refining, after which it is screened to form an accept stock portion (A12) and a reject stock portion (R12).

14. A method as claimed in claim 13 characterised in that the accept stock portion (A12) is taken out of the process.

15. A method as claimed in claims 13 or 14 characterised in that the reject portion (R12) is conveyed back to refining.

16. A method as claimed in claim 7 characterised in that the reject stock fraction (R1) comprises 60-90% by weight of the stock screened.

17. A method as claimed in claims 7 or 16, characterised in that the first reject stock portion (R1) is fed into a second refining stage, and the stock obtained from said second refining stage is screened so as to produce a second accept stock portion (A2) and a second reject stock portion (R2).

18. A method as claimed in claim 17, characterised in that the second accept stock portion (A2) is taken out of the process.

19. A method as claimed in claim 10, characterised in that the first accept stock portion (A1) is screened so as to produce a secondary accept stock portion (A13) and a secondary reject stock portion (R13).

20. A method as claimed in claim 19, characterised in that the secondary accept stock portion (A13) is taken out of the process.

21. A method as claimed in claims 19 or 20, characterised in that the secondary reject stock portion (R13) is conveyed further on to a third refining stage.

22. A method as claimed in claim 17, characterised in that the second reject stock portion (R2) comprises between 60 and 80 % by weight of the stock in the second screening.

23. A method as claimed in claims 17 or 18, characterised in that the second reject stock portion (R2) is conveyed back into the second refining stage.

24. A method as claimed in claims 17, 18 or 22, characterised in that the second reject stock portion (R2) is taken to the third refining stage so as to produce a third refined stock and the stock obtained from said third refining stage is screened so as to form a third accept stock portion (A3) and a third reject stock portion (R3).

25. A method as claimed in claim 24 characterised in that the third accept stock portion (A3) is taken out of the process.

26. A method as claimed in claims 12, 14, or 25 characterised in that the accept stock portions (A11, A12, A3) are combined and mixed to form a ready-made stock.

27. A method as claimed in claims 24 or 25 characterised in that the third reject stock portion (R3) is conveyed back to the third phase of refining.

28. A method as claimed in claims 9, 18, or 25 characterised in that the accept stock portions (A1, A2, A3) are combined and mixed to form a ready-made stock.

29. A method as claimed in claim 18, 20, or 25 characterised in that the accept stocks (A2, A13, A3) are combined and mixed to form a ready-made stock.

30. A method as claimed in claims 24 or 25 characterised in that the third reject stock portion (R3) is conveyed to a fourth phase of refining, and the stock from said fourth stage of refining is screened to form a fourth accept stock (A4) and fourth reject stock (R4).

31. A method as claimed in claim 30 characterised in that the fourth accept stock (A4) is taken out of the process.

32. A method as claimed in claims 30 or 31 characterised in that the fourth reject stock (R4) is conveyed back into the fourth phase of refining.

33. A method as claimed in claim 9, 18, 25, or 31 characterised in that the accept stocks (A1, A2, A3, A4) are combined and mixed to form a ready-made stock.

34. A method as claimed in patent claims 30 or 31, characterised in that the fourth rejected stock portion (R4) is conveyed to a low consistency refiner (LC).

35. A method as claimed in patent claim 34, characterised in that the fifth accept stock portion (A5) refined in the low consistency refiner, is taken out of the process.

36. A method as claimed in patent claims 9, 18, 25, 31 or 35, characterised in that the accept stock portions (A1, A2, A3, A4, A5) are combined and mixed to form a ready-made stock.

37. The use of the stock prepared by a method claimed in any of the above patent claims 1-36 as a raw material for manufacturing printing papers.

38. The use of stock as claimed in patent claim 37 as a raw material for newsprint, coated paper, or supercalendered paper.

39. A printing paper, characterised in that the raw material used is a stock prepared by a method claimed in any of the above patent claims 1-36.

40. Printing paper as claimed in patent claim 39, characterised in that it is a newsprint, coated paper, or supercalendered paper.

41. Stock for use as a raw material for producing printing papers, characterised in that a minimum of 40% by weight of the fibres does not pass through a Bauer-McNett screen, with a mesh size of 28.

42. Stock as claimed in claim 41, characterised in that a maximum of 20% by weight of the fibres are such that they pass through a Bauer-McNett screen with a mesh size of 28, but do not pass through a Bauer-McNett screen with a mesh size of 200.

43. Stock as claimed in claims 41 or 42 characterised in that a minimum of 35 % by weight of the fibres are such that they pass through Bauer-McNett screens with a mesh size of 28 and 200.

44. Stock as claimed in any of the above claims 41–43 characterised in that it has a freeness value of 30–70 ml CSF.

45. The use of stock as claimed in any of the above claims 41–44 as a raw material for printing paper.

46. The use of stock as claimed in claim 45 as a raw material for newsprint, coated paper or supercalendered paper.

47. Printing paper characterised in that stock as claimed in claims 41–44 has been used as its raw material.

48. Printing paper as claimed in claim 47 characterised in that it is newsprint, coated paper or supercalendered paper.

49. Printing paper as claimed in claim 48 characterised in that it is newsprint, the grammage of which is 30–40 g/m^2 measured in conditions where T = 23° C, RH = 50%.

50. Printing paper as claimed in claim 49 characterised in that its filler content is 7–15% measured in conditions where T = 23° C, RH = 50%.

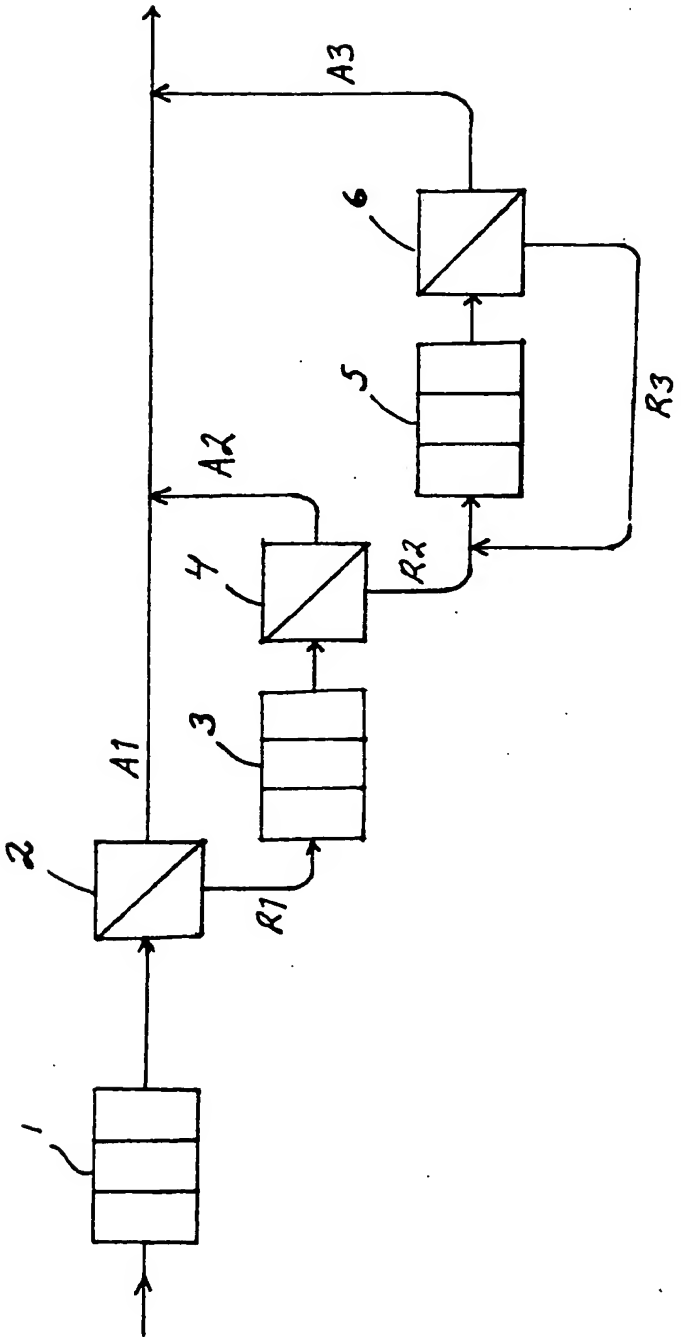


Fig. 1

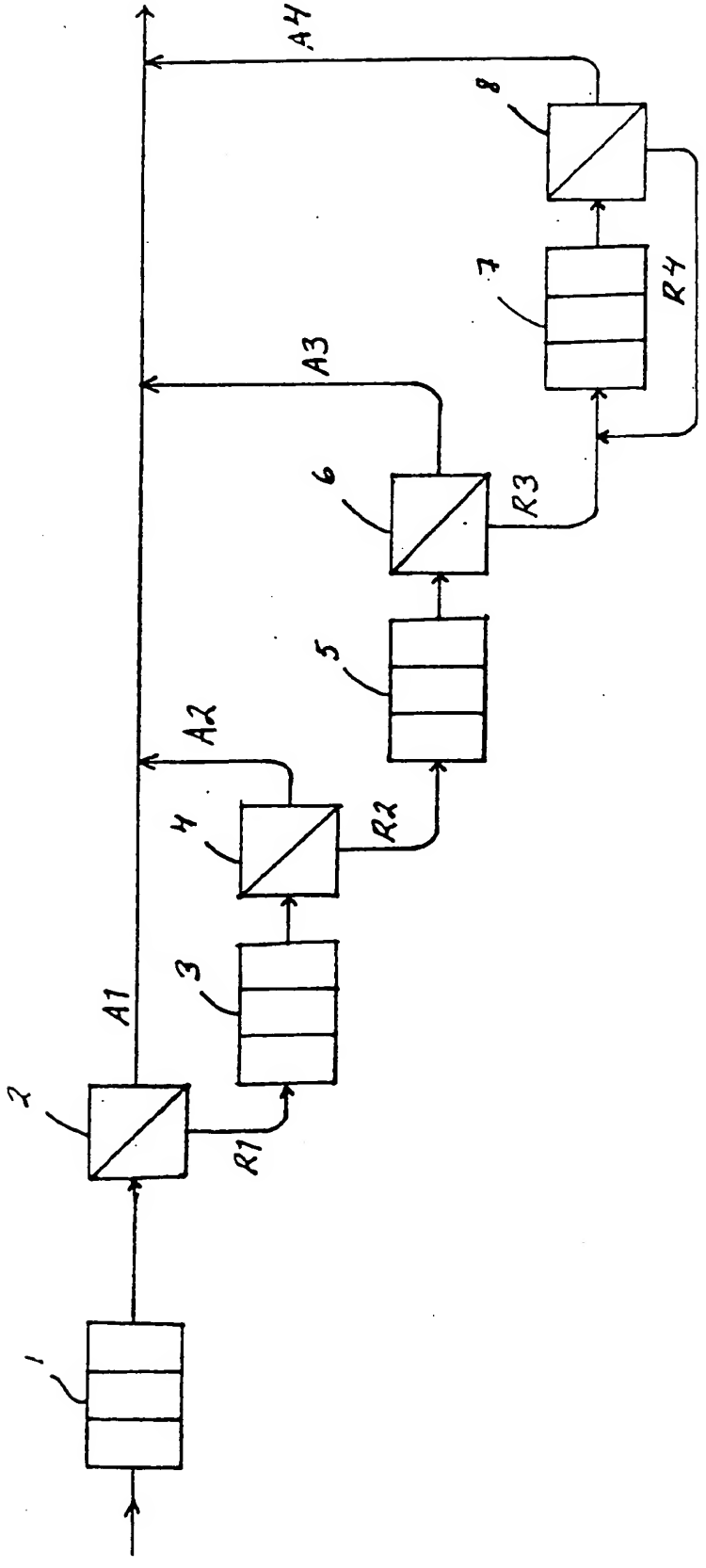


Fig. 2

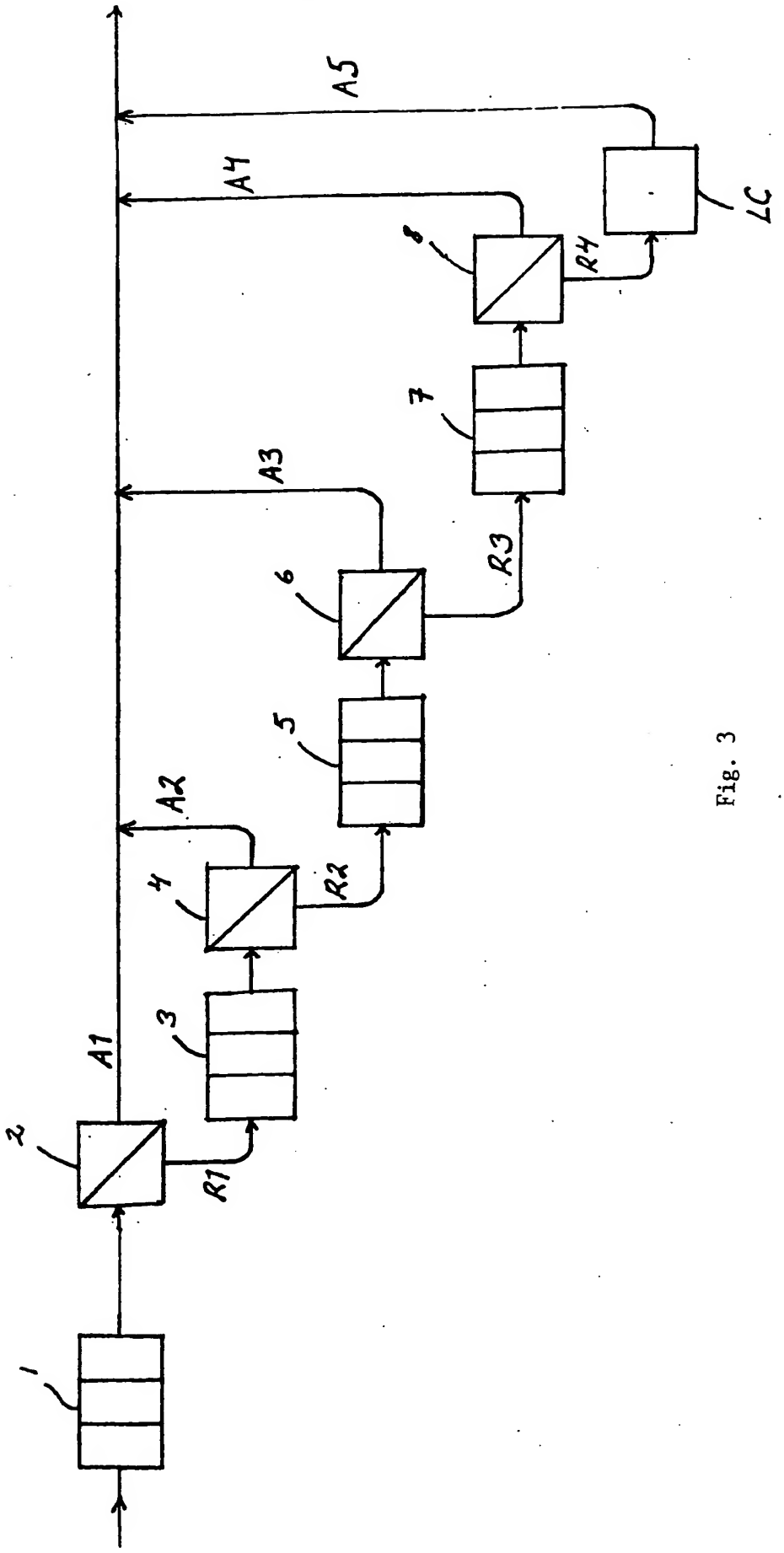


Fig. 3

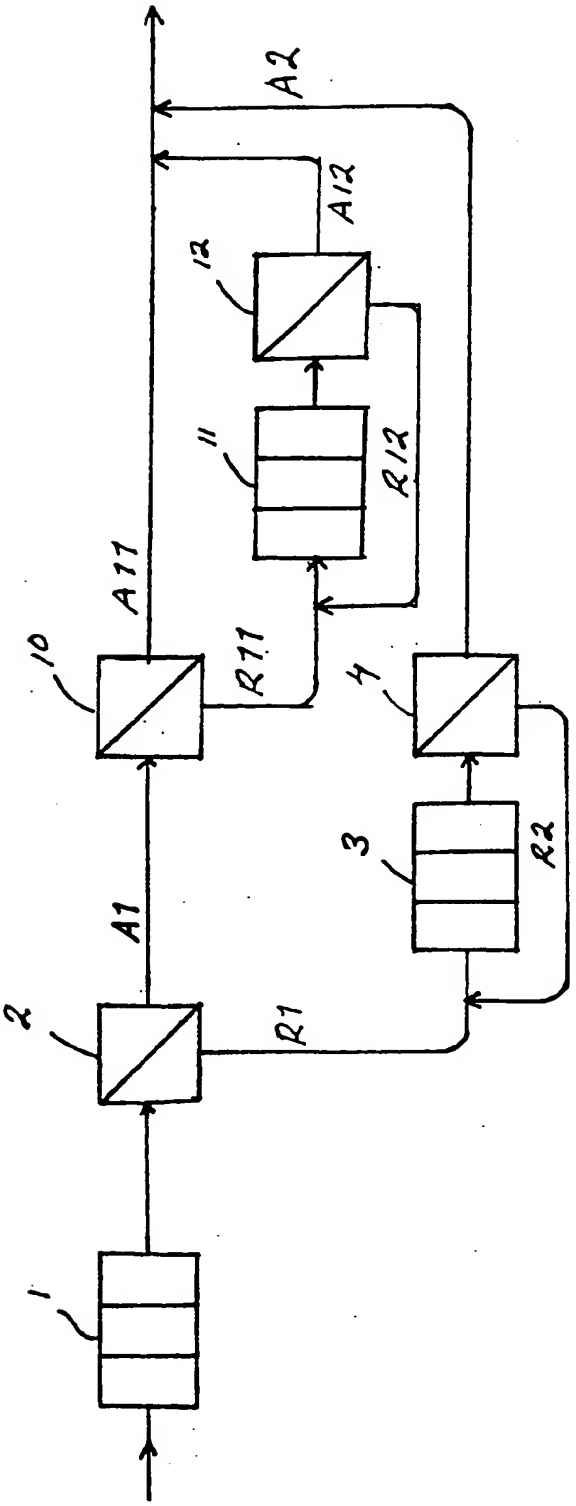


Fig. 4

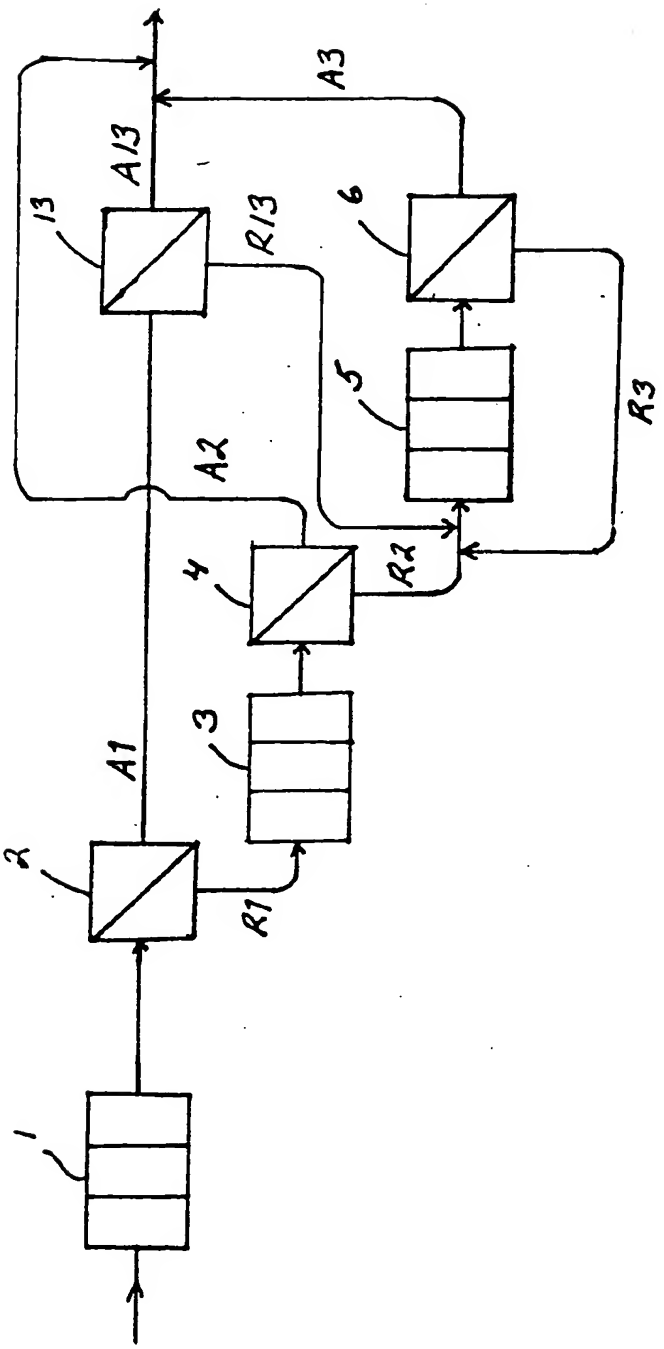


Fig. 5

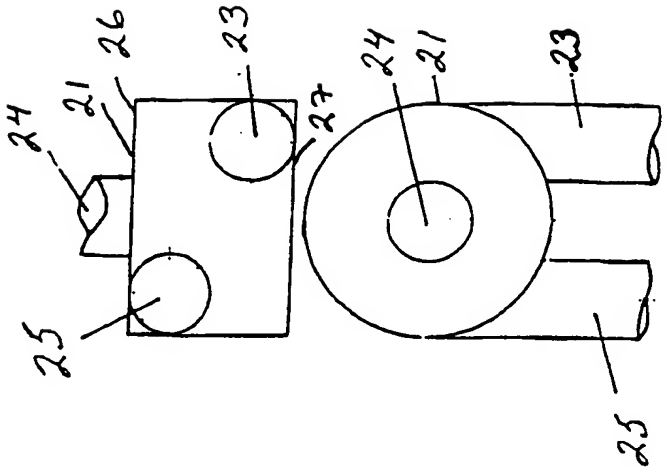


Fig. 6 a

Fig. 6 b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 00/01054

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: D21D 5/02, D21H 11/08, D21C 9/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: D21D, D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0138484 A2 (KAMYR AB), 24 April 1985 (24.04.85), page 4, line 32 - page 5, line 12, abstract --	1-40
X	US 5799798 A (CHAO-HO CHEN), 1 Sept 1998 (01.09.98), abstract --	1-2,4
X	US 5427651 A (JONAS A.I. LINDAHL), 27 June 1995 (27.06.95), abstract --	41-50

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 March 2001	16 -03- 2001
Name and mailing address of the ISA: Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Marianne Bratsberg/ELY Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI00/01054

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI00/01054

1. The invention according to claims 1-40 is directed to a method for sorting mechanical pulp at a consistency of at least 10%.
2. The invention according to claims 41-50 is directed to a pulp and to the use of that specific pulp for production of printing paper.

It is permitted to have a combination of an independent claim for a given product, an independent claim for a process specially adapted for the manufacture of the said product and an independent claim for a use of the said product in the patent application. However, it being understood that a process is specially adapted for the manufacture of a product if it inherently results in the product. Sorting of a mechanical pulp at a consistency of at least 10% as described in claim 1 does not necessary lead to the pulp described in claim 41, which is suitable for manufacturing printing paper.

INTERNATIONAL SEARCH REPORT

Information on patent family members

25/02/01

International application No.
PCT/FI 00/01054

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0138484 A2	24/04/85	BR 8405320 A	03/09/85
		CA 1240456 A	16/08/88
		FI 844071 A	21/04/85
		JP 60146090 A	01/08/85
		NO 844062 A	22/04/85
US 5799798 A	01/09/98	NONE	
US 5427651 A	27/06/95	CA 2072585 A	16/07/91
		FI 923209 A	13/07/92
		SE 465377 B	02/09/91
		SE 9000120 A	16/07/91
		WO 9110774 A	25/07/91
		SE 469110 B,C	17/05/93
		SE 9100020 A	05/07/92